TS8GSSD25-S
TS16GSSD25-S
TS32GSSD25-S/M
TS64GSSD25-S/M
TS128GSSD25-M

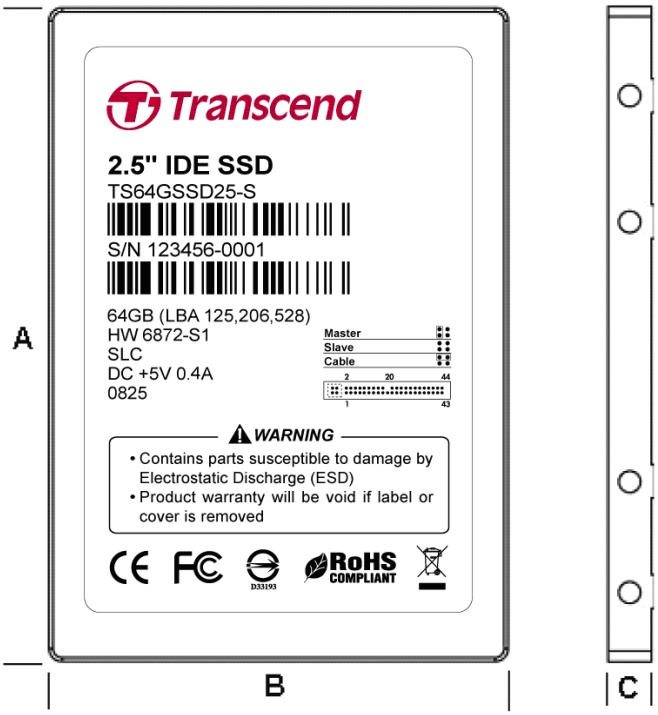
Transcend®

2.5” Solid State Disk

Description

Due to smaller size (fit the standard dimensions of 2.5” IDE Hard Disk Drives), huge capacity, high speed, and low power consumption, Solid State Disk is perfect replacement storage device for PCs, Laptops, gaming systems, and handheld devices.

Placement



Features

- RoHS compliant
- Fully compatible with devices and OS that support the IDE standard (44-Pin, pitch = 2.00 mm)
- Non-volatile Flash Memory for outstanding data retention
- Built-in ECC (Error Correction Code) functionality and wear-leveling algorithm ensures highly reliable of data transfer
- Supports up to Ultra DMA Mode 6
- Shock resistance

Dimensions

Side	Millimeters	Inches
A	100.00 ± 0.40	3.937 ± 0.016
B	69.85 ± 0.20	2.750 ± 0.008
C	7.20 ± 0.15	0.288 ± 0.004

Specifications

Physical Specification		
Form Factor		2.5-inch HDD
Storage Capacities		8 GB to 128 GB
Dimensions (mm)	**Length**	100.0 0 ± 0.40
	Width	69.85 ± 0.20
	Height	7.20 ± 0.15
Input Voltage		3.3V/5V ± 5%
Weight		90g ± 5g
Connector		44-Pin standard IDE/ATA connector (Pitch 2.0 mm)

Environmental Specifications	
Operating Temperature	0 ℃ to 70 ℃
Storage Temperature	- 40 ℃ to 85 ℃

Power Requirements			
Input Voltage		5V ± 5% @25℃	
Mode		**Max. (mA)**	**Max. (W)**
Power Consumption (8/16/32GB)	**Write**$_{(peak)}$	325.5	1.6
	Read$_{(peak)}$	295.7	1.5
	Idle$_{(peak)}$	156.8	0.8
Power Consumption (64/128GB)	**Write**$_{(peak)}$	354.8	1.8
	Read$_{(peak)}$	312.6	1.6
	Idle$_{(peak)}$	156.3	0.8

Interface Specification	
Jumper Settings	Master/Slave/Cable-select Settings
ATA Compatibility	ATA/ATAPI 6
	UDMA Modes 6

Performance		
Model P/N	**Sequential Read**(Max.)	**Sequential Write**(Max.)
TS8GSSD25-S	74 MB/s	62 MB/s
TS16GSSD25-S	74 MB/s	62 MB/s
TS32GSSD25-M	74 MB/s	45 MB/s
TS32GSSD25-S	74 MB/s	62 MB/s
TS64GSSD25-M	75 MB/s	45 MB/s
TS64GSSD25-S	80 MB/s	70 MB/s
TS128GSSD25-M	68 MB/s	46 MB/s

Actual Capacity				
Model P/N	**User Max. LBA**	**Cylinder**	**Head**	**Sector**
TS8GSSD25-S	15,604,848	15,498	16	63
TS16GSSD25-S	31,244,288	16,383	16	63
TS32GSSD25-S	63,078,400	16,383	16	63
TS32GSSD25-M	62,521,344	16,383	16	63
TS64GSSD25-S	126,189,568	16,383	16	63
TS64GSSD25-M	125,206,528	16,383	16	63
TS128GSSD25-M	252,411,904	16,383	16	63

Reliability	
Data Reliability	Supports BCH ECC 8 bits / 15 bits in 512 bytes
Data Retention	10 years
MTBF	1,000,000 hours

Vibration	
Operating	3.0G, 5 - 800Hz
Non-Operating	3.0G, 5 - 800Hz

* Note: Reference to the IEC 60068-2-6 Testing procedures; Operating-Sine wave, 5-800Hz/1 oct., 1.5mm, 3g, 0.5 hr./axis, total 1.5 hrs.

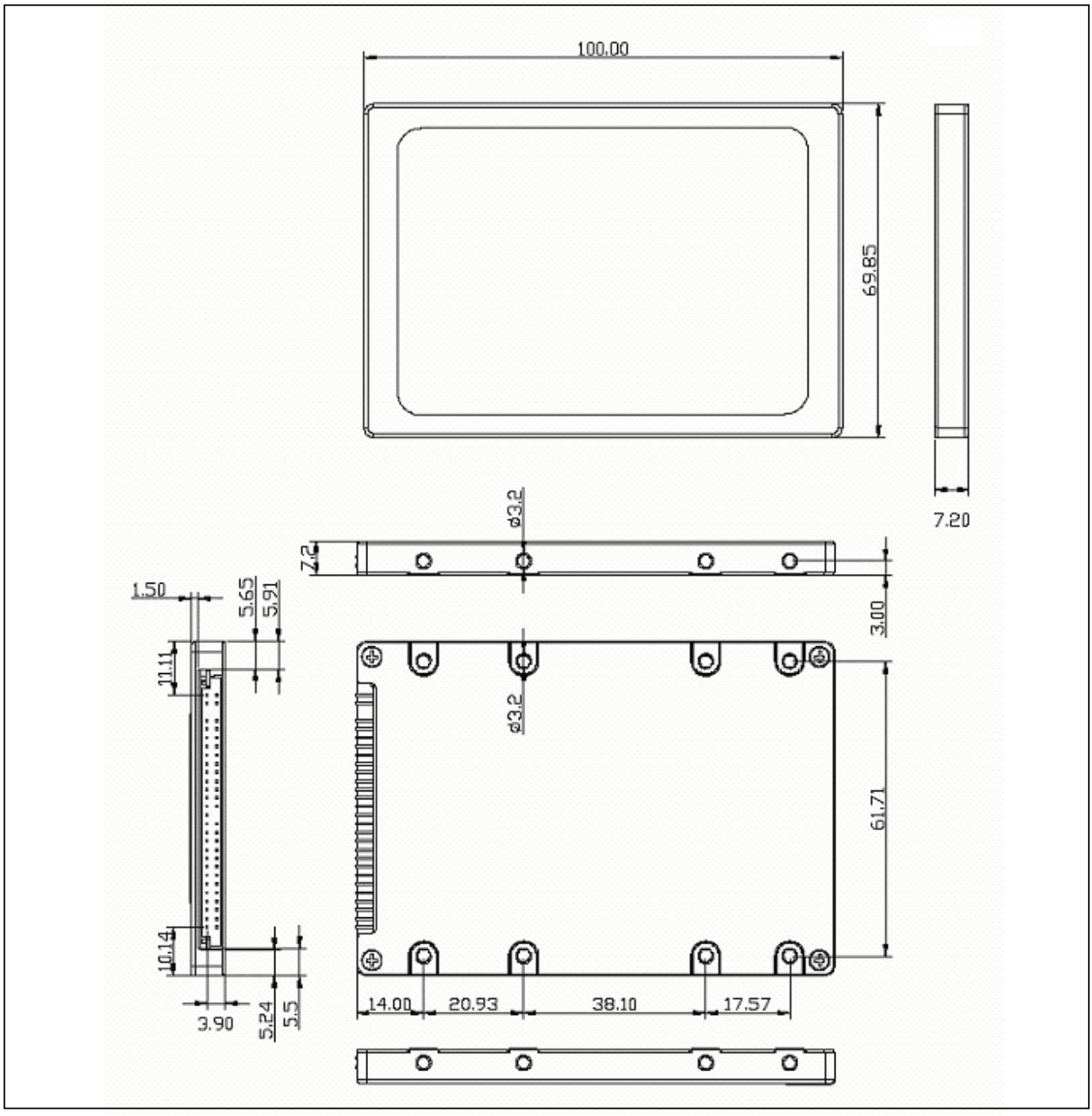
Shock	
Operating	1500G, 0.5ms
Non-Operating	1500G, 0.5ms

* Note: Reference to the IEC 60068-2-27 Testing procedures; Operating-Half-sine wave, 1500g, 0.5ms, 3 times/dir., total 18 times.

Regulations	
Compliance	CE, FCC and BSMI

Package Dimensions

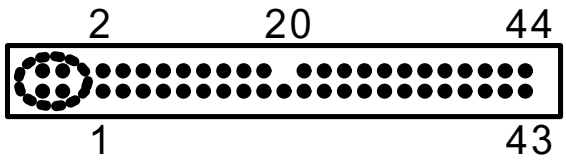
Below figure illustrates the Transcend 2.5” Solid State Disk. All dimensions are in mm.



Pin Assignments

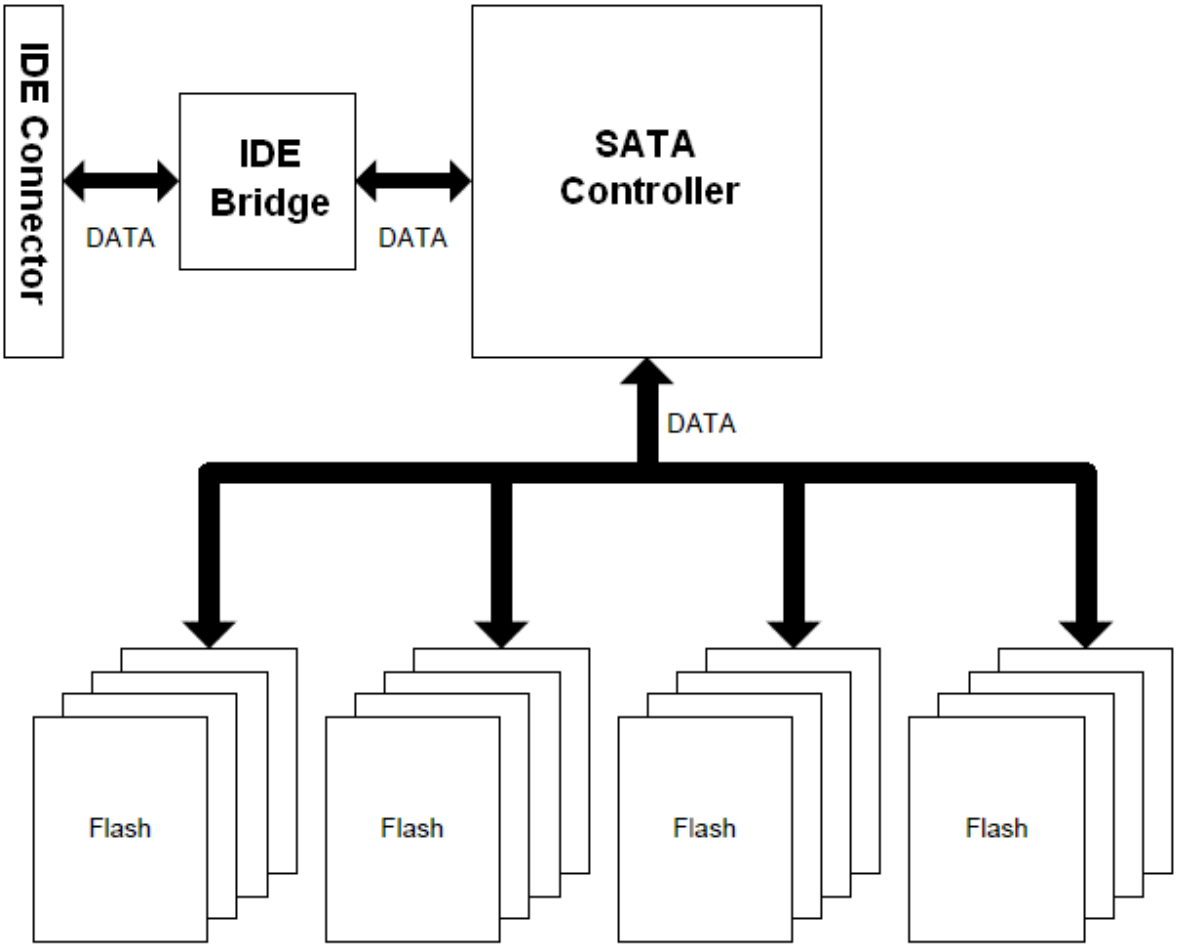
Pin No.	Pin Name	Pin No.	Pin Name
01	-RESET	02	GND
03	DD7	04	DD8
05	DD6	06	DD9
07	DD5	08	DD10
09	DD4	10	DD11
11	DD3	12	DD12
13	DD2	14	DD13
15	DD1	16	DD14
17	DD0	18	DD15
19	GND	20	KEY-PIN (OPEN)
21	DMARQ	22	GND
23	-DIOW : STOP	24	GND
25	-DIOR : -HDMARDY : HSTROBE	26	GND
27	IORDY : DDMARDY : DSTROBE	28	CSEL
29	-DMACK	30	GND
31	INTRQ	32	IOCS16B
33	DA1	34	-PDIAG : -CBLID
35	DA0	36	DA2
37	-CS0	38	-CS1
39	-DASP	40	GND
41	VCC	42	VCC
43	GND	44	NC (No Connect)

Pin Layout



Master Mode Slave Mode Cable Select

Block Diagram



Reliability

Wear-Leveling algorithm

The controller supports static/dynamic wear leveling. When the host writes data, the controller will find and use the block with the lowest erase count among the free blocks. This is known as dynamic wear leveling. When the free blocks' erase count is higher than the data blocks', it will activate the static wear leveling, replacing the not so frequently used user blocks with the high erase count free blocks.

ECC algorithm

The controller uses BCH8/BCH15 ECC algorithm per 512 bytes according to structure of flash. BCH8/BCH15 can correct up to 8 or 15 random error bits within 512 data bytes.

Bad-block management

When the flash encounters ECC failed, program fail or erase fail, the controller will mark the block as bad block to prevent the used of this block and caused data lost later on.

Support ATA/ATAPI Command ListCommand Name	Code	PARAMETERS USED					
		SC	SN	CY	DR	HD	FT
CHECK POWER MODE	E5h	X	X	X	O	X	X
EXECUTE DIAGNOSTICS	90h	X	X	X	O	X	X
FLUSH CACHE	E7h	X	X	X	O	O	X
FLUSH CACHE EXT	EAh	X	X	X	O	O	X
IDENTIFY DEVICE	ECh	X	X	X	O	X	X
IDLE	E3h	O	X	X	O	X	X
IDLE IMMEDIATE	E1h	X	X	X	O	X	X
INITIALIZE DEVICE PARAMETERS	91h	O	X	X	O	O	X
READ BUFFER	E4h	X	X	X	O	X	X
READ DMA	C8h or C9h	O	O	O	O	O	X
READ DMA EXT	25h	O	O	O	O	O	X
READ FPDMA QUEUED	60h	O	O	O	O	O	O
READ LOG EXT	2Fh	O	O	O	O	O	O
READ MULTIPLE	C4h	O	O	O	O	O	X
READ MULTIPLE EXT	29h	O	O	O	O	O	X
READ SECTOR(S)	20h or 21h	O	O	O	O	O	X
READ SECTOR(S) EXT	24h	O	O	O	O	O	X
READ VERIFY SECTOR(S)	40h or 41h	O	O	O	O	O	X
READ VERIFY SECTOR(S) EXT	42h	O	O	O	O	O	X
RECALIBRATE	10h	X	X	X	O	X	X
SECURITY DISABLE PASSWORD	F6h	X	X	X	O	X	X
SECURITY ERASE PREPARE	F3h	X	X	X	O	X	X
SECURITY ERASE UNIT	F4h	X	X	X	O	X	X
SECURITY FREEZE LOCK	F5h	X	X	X	O	X	X
SECURITY SET PASSWORD	F1h	X	X	X	O	X	X
SECURITY UNLOCK	F2h	X	X	X	O	X	X
SEEK	7xh	X	X	O	O	O	X
SET FEATURES	EFh	O	X	X	O	X	O

SET MULTIPLE MODE	C6h	O	X	X	O	X	X
SLEEP	E6h	X	X	X	O	X	X
SMART	B0h	X	X	O	O	X	O
STANDBY	E2h	X	X	X	O	X	X
STANDBY IMMEDIATE	E0h	X	X	X	O	X	X
WRITE BUFFER	E8h	X	X	X	O	X	X
WRITE DMA	CAh or CBh	O	O	O	O	O	X
WRITE DMA EXT	35h	O	O	O	O	O	X
WRITE DMA FUA EXT	3Dh	O	O	O	O	O	X
WRITE FPDMA QUEUED	61h	O	O	O	O	O	O
WRITE MULTIPLE	C5h	O	O	O	O	O	X
WRITE MULTIPLE EXT	39h	O	O	O	O	O	X
WRITE MULTIPLE FUA EXT	CEh	O	O	O	O	O	X
WRITE SECTOR(S)	30h or 31h	O	O	O	O	O	X
WRITE SECTOR(S) EXT	34h	O	O	O	O	O	X

Note:

O = Valid, X = Don't care

SC = Sector Count Register

SN = Sector Number Register

CY = Cylinder Low/High Register

DR = DEVICE SELECT Bit (DEVICE/HEAD Register Bit 4)

HD = HEAD SELECT Bit (DEVICE/HEAD Register Bit 3-0)

FT = Features Register

ATA Command Specifications

CHECK POWER MODE (E5h)

The host can use this command to determine the current power management mode.

EXECUTE DIAGNOSTICS (90h)

This command performs the internal diagnostic tests implemented by the drive.

FLUSH CACHE (E7h)

This command is used by the host to request the device to flush the write cache. If there is data in the write cache, that data shall be written to the media. The BSY bit shall remain set to one until all data has been successfully written or an error occurs.

FLUSH CACHE EXT (EAh)

48-bit feature set mandatory command. This command is used by the host to request the device to flush the write cache. If there is data in the write cache, that data shall be written to the media. The BSY bit shall remain set to one until all data has been successfully written or an error occurs.

IDENTIFY DEVICE (ECh)

This commands read out 512Bytes of drive parameter information. Parameter Information consists of the arrangement and value as shown in the following table. This command enables the host to receive the Identify Drive Information from the device.

Identify Device Information Default Value

Word	Value	F/V	Description
0	0040h	F X X X V X	General configuration bit-significant information: 15 0 = ATA device 14-8 Retired 7-6 Obsolete 5-3 Retired 2 Reserved 1 Retired 0 Reserved
1	3C8Ah 3FFFh	F	Number of logical cylinders 15498 (8GB capacity) 16383 (above 16GB capacity)
2	C837h	V	Specific configuration
3	0010h	F	Number of logical heads
4-5	0000h	X	Retired
6	003Fh	F	Number of logical sector per logical track
7-8	0000h		Reserved for assignment by the CompactFlash_ Association
9	0000h	X	Retired
10-19	XXXXh	F	Serial number (20 ASCII characters)
20-21	0000h	X	Retired
22	0000h	X	Obsolete
23-26	XXXXh	F	Firmware revision (8 ASCII characters)
27-46	XXXXh	F	Model number (40 ASCII characters)
47	8001h	F F F	15-8 80h 7-0 00h = Reserved 01h = Maximum number of 1 sectors on READ/WRITE MULTIPLE commands
48	0000h	F	Reserved
49	2F00h	F F F F F X	Capabilities 15-14 Reserved for the IDENTIFY PACKET DEVICE command. 13 1 = Standby timer values as specified in this standard are supported 0 = Standby timer values shall be managed by the device 12 Reserved for the IDENTIFY PACKET DEVICE command. 11 1 = IORDY supported 0 = IORDY may be supported 10 1 = IORDY may be disabled 9 1 = LBA supported 8 1 = DMA supported. 7-0 Retired

50	4000h		Capabilities
		F	15 Shall be cleared to zero.
		F	14 Shall be set to one.
			13-2 Reserved.
		X	1 Obsolete
		F	0 Shall be set to one to indicate a device specific Standby timer value minimum.
51	0000h	F	15-8 PIO data transfer cycle timing mode
			7-0 Reserved
52	0000h	X	Obsolete
53	0007h	F	15-3 Reserved
		F	2 1 = the fields reported in word 88 are valid
			0 = the fields reported in word 88 are not valid
		F	1 1 = the fields reported in words 70:64 are valid
			0 = the fields reported in words 70:64 are not valid
		X	0 1 = the fields reported in words 58:54 are valid
			0 = the fields reported in words 58:54 are not valid
54	XXXXh	X	Number of current cylinders
55	00XXh	X	Number of current heads
56	XXXXh	X	Number of current sector per track
57-58	XXXXh	X	Current capacity in sectors
59	0101h		15-9 Reserved
		V	8 1 = Multiple sector setting is valid
		V	7-0 xxh = Setting for number of sectors that shall be transferred per interrupt on R/W Multiple command
60-61	XXXXh	F	Total number of user addressable sectors
62	0000h	X	Obsolete
63	0007h	F	15-11 Reserved
		V	10 1 = Multiword DMA mode 2 is selected
			0 = Multiword DMA mode 2 is not selected
		V	9 1 = Multiword DMA mode 1 is selected
			0 = Multiword DMA mode 1 is not selected
		V	8 1 = Multiword DMA mode 0 is selected
			0 = Multiword DMA mode 0 is not selected
			7-3 Reserved
		F	2 1 = Multiword DMA mode 2 and below are supported
		F	1 1 = Multiword DMA mode 1 and below are supported
		F	0 1 = Multiword DMA mode 0 is supported
64	0003h		15-8 Reserved
		F	7-0 Advanced PIO modes supported
65	0078h	F	Minimum Multiword DMA transfer cycle time per word
66	0078h	F	Manufacturer’s recommended Multiword DMA transfer cycle time
67	0078h	F	Minimum PIO transfer cycle time without flow control
68	0078h	F	Minimum PIO transfer cycle time with IORDY flow control

69-70	0000h		Reserved
71-74	0000h		Reserved for the IDENTIFY PACKET DEVICE command
75	0000h		Queue depth
			15-5 Reserved
		F	4-0 Maximum queue depth – 1
76	0002h		Serial ATA Capabilities
			15-11 Reserved for Serial ATA
		F	10 1 = Supports Phy Event Counts
		F	9 1 = Supports receipt of host initiated power management requests
		F	8 1 = Supports the NCQ feature set
			7-3 Reserved for Serial ATA
		F	2 1 = Supports SATA Gen2 Signaling Speed (3.0Gb/s)
		F	1 1 = Supports SATA Gen1 Signaling Speed (1.5Gb/s)
		F	0 Shall be cleared to zero
77	0000h		Reserved for Serial ATA
78	0000h		Serial ATA feature supported
			15-7 Reserved for Serial ATA
		F	6 1 = Device supports Software Settings Preservation
			5 Reserved for Serial ATA
		F	4 1 = Device supports in-order data delivery
		F	3 1 = Device supports initiating power management
		F	2 1 = Device supports DMA Setup auto-activation
		F	1 1 = Device supports non-zero buffer offsets
		F	0 Shall be cleared to zero
79	0000h		Serial ATA feature enabled
			15-7 Reserved for Serial ATA
		V	6 1 = Software Settings Preservation enabled
			5 Reserved for Serial ATA
		V	4 1 = In-order data delivery enabled
		V	3 1 = Device initiated power management enabled
		V	2 1 = DMA Setup auto-activation enabled
		V	1 1 = Non-zero buffer offsets enabled
		F	0 Shall be cleared to zero

80	00F0h		Major version number 0000h or FFFFh = device does not report version
			15 Reserved
		F	14 Reserved for ATA/ATAPI-14
		F	13 Reserved for ATA/ATAPI-13
		F	12 Reserved for ATA/ATAPI-12
		F	11 Reserved for ATA/ATAPI-11
		F	10 Reserved for ATA/ATAPI-10
		F	9 Reserved for ATA/ATAPI-9
		F	8 Reserved for ATA/ATAPI-8
		F	7 1 = supports ATA/ATAPI-7
		F	6 1 = supports ATA/ATAPI-6
		F	5 1 = supports ATA/ATAPI-5
		F	4 1 = supports ATA/ATAPI-4
		F	3 Obsolete
		X	2 Obsolete
		X	1 Obsolete
			0 Reserved
81	0000h	F	Minor version number
82	304Bh		Command and feature sets supported
		X	15 Obsolete
		F	14 1 = NOP command supported
		F	13 1 = READ BUFFER command supported
		F	12 1 = WRITE BUFFER command supported
		X	11 Obsolete
		F	10 1 = Host Protected Area feature set supported
		F	9 1 = DEVICE RESET command supported
		F	8 1 = SERVICE interrupt supported
		F	7 1 = release interrupt supported
		F	6 1 = look-ahead supported
		F	5 1 = write cache supported
		F	4 Shall be cleared to zero to indicate that the PACKET Command feature set is not supported.
		F	3 1 = mandatory Power Management feature set supported
		F	2 1 = Removable Media feature set supported
		F	1 1 = Security Mode feature set supported
		F	0 1 = SMART feature set supported

83	7400h		Command and feature sets supported
		F	15 Shall be cleared to zero
		F	14 Shall be set to one
		F	13 1 = The FLUSH CACHE EXT command is supported
		F	12 Shall be set to one to indicate that the mandatory FLUSH CACHE command is supported
		F	11 1 = The DCO feature set is supported
		F	10 1 = The 48-bit Address feature set is suported
		F	9 1 = The AAM feature set is supported
		F	8 1 = SET MAX security extension supported
			7 Reserved
		F	6 1 = SET FEATURES subcommand required to spinup after power-up
		F	5 1 = Power-Up In Standby feature set supported
		F	4 1 = Removable Media Status Notification feature set supported
		F	3 1 = Advanced Power Management feature set supported
		F	2 1 = CFA feature set supported
		F	1 1 = READ/WRITE DMA QUEUED supported
		F	0 1 = DOWNLOAD MICROCODE command supported
84	4060h		Command and feature sets supported
		F	15 Shall be cleared to zero
		F	14 Shall be set to one
		F	13 1 = The IDLE IMMEDIATE command with UNLOAD feature is supported
			12-11 Reserved for TLC
		X	10-9 Obsolete
		F	8 1 = The 64-bit World wide name is supported
		F	7 1 = The WRITE DMA QUEUED FUA EXT command is supported
		F	6 1 = The WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands are supported
		F	5 1 = The GPL feature set is supported
		F	4 1 = The Streaming feature set is supported
		F	3 1 = The Media Card Pass Through Command feature set is supported
		F	2 1 = Media serial number is supported
		F	1 1 = SMART self-test supported
		F	0 1 = SMART error logging supported

85	3069h			Command and feature sets supported or enable (Depend on the host enabling)
		X	15	Obsolete
		F	14	1 = The NOP command is supported
		F	13	1 = The READ BUFFER command is supported
		F	12	1 = The WRITE BUFFER command is supported
		X	11	Obsolete
		V	10	1 = HPA feature set is supported
		F	9	Shall be cleared to zero to indicate that the DEVICE RESET command is not supported
		V	8	1 = The SERVICE interrupt is enabled
		V	7	1 = The release interrupt is enabled
		V	6	1 = Read look-ahead is enabled
		V	5	1 = The volatile write cache is enabled
		F	4	Shall be cleared to zero to indicate that the PACKET Command feature set is not supported.
		F	3	Shall be set to one to indicate that the mandatory Power Management feature is supported
		X	2	Obsolete
		V	1	1 = The Security feature set is enabled
		V	0	1 = The SMART feature set is enabled
86	3400h			Command and feature sets supported or enable (Depend on the host enabling)
		F	15	1 = Words 119-120 are valid
			14	Reserved
		F	13	1 = FLUSH CACHE EXT command supported
		F	12	1 = FLUSH CACHE command supported
		F	11	1 = The DCO feature set is supported
		F	10	1 = The 48-bit Address feature set is supported
		V	9	1 = The AAM feature set is enable
		V	8	1 = The SET MAX security extension is enabled by SET MAX SET PASSWORD
			7	Reserved for Address Offset Reserved Area Boot Method
		F	6	1 = SET FEATURES subcommand required to spin-up after power-up
		V	5	1 = The PUIS feature set is enabled
		X	4	Obsolete
		V	3	1 = The APM feature set is enabled
		F	2	1 = The CFA feature set is supported
		F	1	1 = The TCQ feature set is supported
		F	0	1 = The DOWNLOAD MICROCODE command is supported

87	4060h		Command and feature sets supported or enabled (Depend on the host enabling)
		F	15 Shall be cleared to zero
		F	14 Shall be set to one
		F	13 1 = The IDLE IMMEDIATE command with UNLOAD feature is supported
			12-11 Reserved for TLC
		X	10-9 Obsolete
		F	8 1 = The 64-bit World wide name is supported
		F	7 1 = The WRITE DMA QUEUED FUA EXT command is supported
		F	6 1 = The WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands are supported
		F	5 1 = The GPL feature set is supported
		X	4 Obsolete
		V	3 1 = The Media Card Pass Through Command feature set is supported
		V	2 1 = Media serial number is supported
		F	1 1 = SMART self-test supported
		F	0 1 = SMART error logging supported
88	XX7Fh		Ultra DMA modes(XX depends on the host selecting)
			15 Reserved
		V	14 1 = Ultra DMA mode 6 is selected
			0 = Ultra DMA mode 6 is not selected
		V	13 1 = Ultra DMA mode 5 is selected
			0 = Ultra DMA mode 5 is not selected
		V	12 1 = Ultra DMA mode 4 is selected
			0 = Ultra DMA mode 4 is not selected
		V	11 1 = Ultra DMA mode 3 is selected
			0 = Ultra DMA mode 3 is not selected
		V	10 1 = Ultra DMA mode 2 is selected
			0 = Ultra DMA mode 2 is not selected
		V	9 1 = Ultra DMA mode 1 is selected
			0 = Ultra DMA mode 1 is not selected
		V	8 1 = Ultra DMA mode 0 is selected
			0 = Ultra DMA mode 0 is not selected
			7 Reserved
		F	6 1 = Ultra DMA mode 6 and below are supported
		F	5 1 = Ultra DMA mode 5 and below are supported
		F	4 1 = Ultra DMA mode 4 and below are supported
		F	3 1 = Ultra DMA mode 3 and below are supported
		F	2 1 = Ultra DMA mode 2 and below are supported
		F	1 1 = Ultra DMA mode 1 and below are supported
		F	0 1 = Ultra DMA mode 0 is supported
89	0001h		15-8 Reserved
		F	7-0 Time required for Normal Erase mode SECURITY ERASE UNIT command
90	0001h		15-8 Reserved
		F	7-0 Time required for Enhanced Erase mode SECURITY ERASE UNIT command
91	0000h	V	Current APM level value
92	FFFEh	V	Master Password Identifier
93	0000h	X	Hardware reset result

94	0000h	F V	Current AAM value 15-8 Vendor’s recommended AAM value 7-0 Current AAM value
95-99	0000h		Reserved
100-103	XXXXh	X	Total Number of User Addressable Logical Sectors for 48-bit commands (QWord)
104-105	0000h		Reserved
106	4000h	 F F F F F	Physical sector size / logical sector size 15 Shall be cleared to zero 14 Shall be set to one 13 1 = Device has multiple logical sectors per physical sector 12 1 = Device Logical Sector longer than 256 Words 11-4 Reserved 3-0 2x logical sectors per physical sector
107-118	0000h		Reserved
119	4000h	 F F F F F F F	Commands and feature sets supported (Continued from words 84:82) 15 Shall be cleared to zero 14 Shall be set to one 13-6 Reserved 5 1= The Free-fall Control feature set is supported 4 1 = The DOWNLOAD MICROCODE command with mode 3 is supported 3 1 = The READ LOG DMA EXT and WRITE LOG DMA EXT commands are supported 2 1 = The WRITE UNCORRECTABLE EXT command is supported 1 1 = The Write-Read-Verify feature set is supported 0 Reserved for DDT
120	4000h	 F F V F F F V	Commands and feature sets supported or enabled (Continued from words 87:85) 15 Shall be cleared to zero 14 Shall be set to one 13-6 Reserved 5 1= The Free-fall Control feature set is enabled 4 1 = The DOWNLOAD MICROCODE command with mode 3 is supported 3 1 = The READ LOG DMA EXT and WRITE LOG DMA EXT commands are supported 2 1 = The WRITE UNCORRECTABLE EXT command is supported 1 1 = The Write-Read-Verify feature set is enabled 0 Reserved for DDT
121-126	0000h		Reserved for expended supported and enabled settings
127	0000h	X	Obsolete
128	0021h	 F V F F V V V F	Security status 15-9 Reserved 8 Security level 0 = High, 1 = Maximum 7-6 Reserved 5 1 = Enhanced security erase supported 4 1 = Security count expired 3 1 = Security frozen 2 1 = Security locked 1 1 = Security enabled 0 1 = Security supported

129-159	0000h	X	Vendor specific
160-216	0000h		Reserved
217	0001h	F	Nominal media rotation rate
218-254	0000h		Reserved
255	0000h	X	Integrity word 15-8 Checksum 7-0 Signature

Key:
F/V = Fixed/variable content
F = the content of the word is fixed and does not change. For removable media devices, these values may change when media is removed or changed.
V = the contents of the word is variable and may change depending on the state of the device or the commands executed by the device.
X = the content of the word may be fixed or variable.

IDLE (E3h)

This command causes the device to set BSY, enter the Idle mode, clear BSY and generate an interrupt. If sector count is non-zero, the automatic power down mode is enabled. If the sector count is zero, the automatic power mode is disabled.

IDLE IMMEDIATE (E1h)

This command causes the device to set BSY, enter the Idle(Read) mode, clear BSY and generate an interrupt.

INITIALIZE DEVICE PARAMETERS (91h)

This command enables the host to set the number of sectors per track and the number of tracks per heads.

READ BUFFER (E4h)

The READ BUFFER command enables the host to read a 512-byte block of data.

READ DMA (C8h)

Read data from sectors during Ultra DMA and Multiword DMA transfer. Use the SET FEATURES command to specify the mode value. A sector count of zero requests 256 sectors.

READ DMA EXT (25h)

48-bit feature set mandatory command. Read data from sectors during Ultra DMA and Multiword DMA transfer. Use the SET FEATURES command to specify the mode value. A sector count of zero requests 65536 sectors.

READ FPDMA QUEUED (60h)

NCQ feature set mandatory 48-bit command. This command requests that data to be transferred from the device to the host.

READ LOG EXT (2Fh)

General purpose logging feature set mandatory 48-bit command. This command returns the specified log to the host.

Log Address	Log Name	Feature Set	R/W	Access
00h	Log directory	N/A	RO	GPL
10h	NCQ Command Error	NCQ	RO	GPL

READ MULTIPLE (C4h)

This command performs similarly to the Read Sectors command. Interrupts are not generated on each sector, but on the transfer of a block which contains the number of sectors defined by a Set Multiple command.

READ MULTIPLE EXT (29h)

48-bit feature set mandatory command. This command performs similarly to the Read Sectors command. Interrupts are not generated on each sector, but on the transfer of a block which contains the number of sectors defined by a Set Multiple command.

READ SECTOR(S) (20h/21h)

This command reads 1 to 256 sectors as specified in the Sector Count register from sectors which is set by Sector number register. A sector count of 0 requests 256 sectors. The transfer beings specified in the Sector Number register.

READ SECTOR(S) EXT (24h)

48-bit feature set mandatory command. This command reads 1 to 65536 sectors as specified in the Sector Count register from sectors which is set by Sector number register. A sector count of zero requests 65536 sectors. The transfer beings specified in the Sector Number register.

READ VERIFY SECTOR(S) (40h/41h)

This command verifies one or more sectors on the drive by transferring data from the flash media to the data buffer in the drive and verifying that the ECC is correct. This command is identical to the Read Sectors command, except that DRQ is never set and no data is transferred to the host.

READ VERIFY SECTOR(S) EXT (42h)

48-bit feature set mandatory command. This command verifies one or more sectors on the drive by transferring data from the flash media to the data buffer in the drive and verifying that the ECC is correct. This command is identical to the Read Sectors command, except that DRQ is never set and no data is transferred to the host.

RECALIBRATE (10h)

The current drive performs no processing if it receives this command. It is supported for backward compatibility with previous devices.

SECURITY DISABLE PASSWORD (F6h)

Disables any previously set user password and cancels the lock. The host transfers 512 bytes of data, as shown in the following table, to the drive. The transferred data contains a user or master password, which the drive compares with the saved password. If they match, the drive cancels the lock. The master password is still saved. It is re-enabled by issuing the SECURITY SET PASSWORD command to re-set a user password.

SECURITY ERASE PREPARE (F3h)

This command shall be issued immediately before the Security Erase Unit command to enable erasing and unlocking. This command prevents accidental loss of data on the drive.

SECURITY ERASE UNIT (F4h)

The host uses this command to transfer 512 bytes of data, as shown in the following table, to the drive. The transferred data contains a user or master password, which the drive compares with the saved password. If they match, the drive deletes user data, disables the user password, and cancels the lock. The master password is still saved. It is re-enabled by issuing the SECURITY SET PASSWORD command to re-set a user password.

SECURITY FREEZE LOCK (F5h)

Causes the drive to enter Frozen mode. Once this command has been executed, the following commands to update a lock result in the Aborted Command error:

- SECURITY SET PASSWORD
- SECURITY UNLOCK
- SECURITY DISABLE PASSWORD
- SECURITY ERASE PREPARE
- SECURITY ERASE UNIT

The drive exits from Frozen mode upon a power-off or hard reset. If the SECURITY FREEZE LOCK command is issued when the drive is placed in Frozen mode, the drive executes the command, staying in Frozen mode.

SECURITY SET PASSWORD (F1h)

This command set user password or master password. The host outputs sector data with PIO data-out protocol to indicate the information defined in the following table.

Security set Password data content

Word	Content		
0	Control word		
	Bit 0	Identifier	0=set user password 1=set master password
	Bits 1-7	Reserved	
	Bit 8	Security level	0=High 1=Maximum
	Bits 9-15	Reserved	
1-16	Password (32 bytes)		
17-255	Reserved		

SECURITY UNLOCK (F2h)

This command disable LOCKED MODE of the device. This command transfers 512 bytes of data from the host with PIO data-out protocol. The following table defines the content of this information.

Security Unlock information

Word	Content		
0	Control word		
	Bit 0	Identifier	0=compare user password 1=compare master password
	Bits 1-15	Reserved	
1-16	Password (32 bytes)		
17-255	Reserved		

SEEK (7xh)

This command is effectively a NOP command to the device although it does perform a range check.

SET FEATURES (EFh)

This command set parameter to Features register and set drive’s operation. For transfer mode, parameter is set to Sector Count register. This command is used by the host to establish or select certain features.

Features register Value and settable operating mode

Value	Function
02h	Enable write cache
03h	Set transfer mode based on value in Sector Count register.
55h	Disable read look-ahead feature
82h	Disable write cache
AAh	Enable read look-ahead feature

SET MULTIPLE MODE (C6h)

This command enables the device to perform READ MULTIPLE and WRITE MULTIPLE operations and establishes the block count for these commands.

SLEEP (E6h)

This command causes the device to set BSY, enter the Sleep mode, clear BSY and generate an interrupt.

SMART Function Set (B0h)

Performs different processing required for predicting device failures, according to the subcommand specified in the Features register. If the Features register contains an unsupported value, the Aborted Command error is returned. If the SMART function is disabled, any subcommand other than SMART ENABLE OPERATIONS results in the Aborted Command error.

Code	Smart Subcommand
D0h	READ DATA
D1h	READ ATTRIBUTE THRESHOLDS
D2h	ENABLE/DISABLE ATTRIBUTE AUTOSAVE
D3h	SAVE ATTRIBUTE VALUES
D5h	Reserved
D6h	Reserved
D8h	ENABLE OPERATIONS

D9h	DISABLE OPERATIONS
DAh	RETURN STATUS

SMART READ DATA

This command returns 512-byte SMART Data Structure to the host with PIO data-in protocol. The register file has to contain D0h for Features register, 4Fh for LBA Mid register and C2h for the LBA High register.

Byte	Description
0-1	Data structure revision number
2-13	1st attribute data
14-361	2nd-30th Individual attribute data
362	Off-line data collection status
363	Reserved
364-365	Total time in seconds to complete off-line data collection
366	Reserved
367	Off-line data collection capability
368-369	SMART capability
370-385	Reserved
386-510	Reserved
511	Data structure Checksum

Byte 2-361: Individual attribute data

Byte	Description
0	Attribute ID
1-2	Status Flag (0x0002)
3	Attribute Value (0x64)
4-11	Vendor Specific

The attribute ID information is listed in the following table

ID	Description	Detail Information	
		Byte	Description
E5h	Halt System ID, Flash ID	0	Halt System ID
		1	Flash ID (byte 1)
		2	Flash ID (byte 2)
		3	Flash ID (byte 3)
		4	Flash ID (byte 4)
		5	Flash ID (byte 5)
		6	Flash ID (byte 6)
		7	Flash ID (byte 7)
E8h	Firmware version information	0	Year (High Byte, ASCII)
		1	Year (Low Byte, ASCII)
		2	Month (High Byte, ASCII)
		3	Month (Low Byte, ASCII)
		4	Day (High Byte, ASCII)
		5	Day (Low Byte, ASCII)
		6	Channels (binary)
		7	Banks (binary)
E9h	ECC Fail Record	0	ECC fail number
		1	Row address 3
		2	Row address 2
		3	Row address 1
		4	Channel number of last ECC fail
		5	Bank number of last ECC fail
		6	Reserved
		7	Reserved

EAh	Average Erase Count, Max Erase Count	0 1 2 3 4 5 6 7	Average Erase Count (High Byte) Average Erase Count Average Erase Count (Low Byte) Max Erase Count (High Byte) Max Erase Count Max Erase Count (Low Byte) Reserved Reserved
EBh	Good Block Count, System Block Count	0 1 2 3 4 5 6 7 	Good Block Count (High Byte) Good Block Count Good Block Count (Low Byte) System(Free) Block Count (High Byte) System(Free) Block Count (Low Byte) Reserved Reserved Reserved
ECh-FFh	Reserved		

SMART READ ATTRIBUTE THRESHOLD

This transfers 512 bytes of drive failure threshold data to the host.

SMART ENABLE/DISABLE ATTRIBUTE AUTOSAVE

Enables or disables the attribute value autosave function. This command specifies whether the current attribute values are automatically saved to the drive when it changes the mode. This setting is maintained when the power is turned on and off.

SMART SAVE ATTRIBUTE VALUE

Saves any modified attribute values.

SMART EXECUTE OFF-LINE IMMEDIATE

This command of Non-data input causes the controller to immediately initiate the set of activities that collect SMART data in a off-line mode and then save data to the Nand flash memory, or execute a selfdiagnostic test routine in either captive or off-line mode.

SMART ENABL OPERATIONS

Enables the SMART function. This setting is maintained when the power is turned off and then back on. Once the SMART function is enabled, subsequent SMART ENABLE OPERATIONS commands do not affect any parameters.

SMART DISABLE OPERATIONS

Disables the SMART function. Upon receiving the command, the drive disables all SMART operations. This setting is maintained when the power is turned off and then back on.

Once this command has been received, all SMART commands other than SMART ENABLE OPERATIONS are aborted with the Aborted Command error.

This command disables all SMART capabilities including any and all timer and event count functions related exclusively to this feature. After command acceptance, this controller will disable all SMART operations. SMART data in no longer be monitored or saved. The state of SMART is preserved across power cycles.

SMART RETURN STATUS

Reports the drive reliability status.

Values reported when a predicted defect has not been detected:

Cylinder Low register: 4Fh

Cylinder High register: C2h

Values reported when a predicted defect has been detected:

Cylinder Low register: F4h

Cylinder High register: 2Ch

SMART ENABLE/DISABLE AUTOMATIC OFF-LINE

Enables (when Sector Count register = “F8h”) or disables (Sector Count register = “00h”) the automatic off-line data collection function. The automatic collection is disabled if a value of “00h” is set in the Sector Count register before a subcommand is issued. If automatic collection is disabled, the drive can still save attribute information during normal operation, such as during the power-on/off sequence or error correction sequence. The automatic collection function is enabled if a value of “F8h” is set in the Sector Count register before the command is issued. Values other than “00h” and “F8h” are vendor-specific.

STANDBY (E2h)

This command causes the device to set BSY, enter the Sleep mode (which corresponds to the ATA “Standby” Mode), clear BSY and return the interrupt immediately.

STANDBY IMMEDIATE (E0h)

This command causes the drive to set BSY, enter the Sleep mode (which corresponds to the ATA “Standby” Mode), clear BSY and return the interrupt immediately.

WRITE BUFFER (E8h)

This command enables the host to write the contents of one 512-byte block of data to the device’s buffer.

WRITE DMA (CAh)

Write data to sectors during Ultra DMA and Multiword DMA transfer. Use the SET FEATURES command to specify the mode value.

WRITE DMA EXT (35h)

48-bit feature set mandatory command. Write data to sectors during Ultra DMA and Multiword DMA transfer. Use the SET FEATURES command to specify the mode value.

WRITE DMA FUA EXT (3Dh)

48-bit feature set mandatory command. This command provides the same function as the WRITE DMA EXT command except that regardless of whether volatile and/or non-volatile write caching in the device is enabled or not, the user data shall be written to non-volatile media before command completion is reported.

WRITE FPDMA QUEUED (61h)

NCQ feature set mandatory 48-bit command. This command causes data to be transferred from the host to the device.

WRITE MULTIPLE (C5h)

This command is similar to the Write Sectors command. Interrupts are not presented on each sector, but on the transfer of a block which contains the number of sectors defined by Set Multiple command.

WRITE MULTIPLE EXT (39h)

48-bit feature set mandatory command. This command is similar to the Write Sectors command. Interrupts are not presented on each sector, but on the transfer of a block which contains the number of sectors defined by Set Multiple command.

WRITE MULTIPLE FUA EXT (CEh)

48-bit feature set mandatory command. This command provides the same functionality as the WRITE MULTIPLE EXT command except that regardless of whether volatile and/or non-volatile write caching in the device is enabled or not, the user data shall be written to non-volatile media before command completion is reported.

WRITE SECTOR(S) (30h/31h)

Write data to a specified number of sectors (1 to 256, as specified with the Sector Count register) from the specified address. Specify “00h” to write 256 sectors.

WRITE SECTOR(S) EXT (34h)

48-bit feature set mandatory command. Write data to a specified number of sectors (1 to 65536, as specified with the Sector Count register) from the specified address. Specify “00h” to write 65536 sectors.

Ultra DMA data transfer

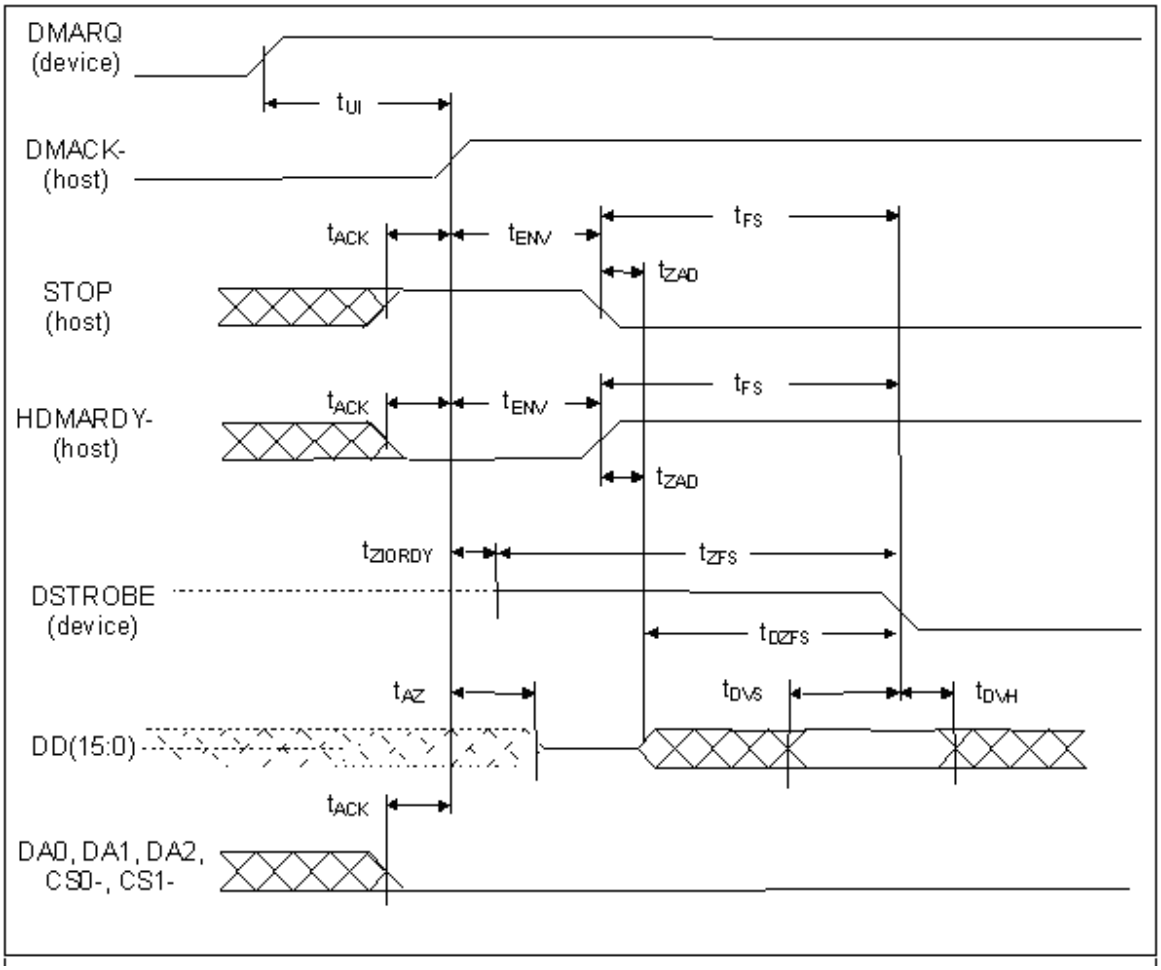
Ultra DMA data burst timing requirements

Name	Mode 0 (in ns)		Mode 1 (in ns)		Mode 2 (in ns)		Mode 3 (in ns)		Mode 4 (in ns)		Mode 5 (in ns)		Mode 6 (in ns)		Measurement location
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
$t_{2CYCTYP}$	240		160		120		90		60		40		30		Sender
t_{CYC}	112		73		54		39		25		16.8		13.0		Note 3
t_{2CYC}	230		153		115		86		57		38		29		Sender
t_{DS}	15.0		10.0		7.0		7.0		5.0		4.0		2.6		Recipient
t_{DH}	5.0		5.0		5.0		5.0		5.0		4.6		3.5		Recipient
t_{DVS}	70.0		48.0		31.0		20.0		6.7		4.8		4.0		Sender
t_{DVH}	6.2		6.2		6.2		6.2		6.2		4.8		4.0		Sender
t_{CS}	15.0		10.0		7.0		7.0		5.0		5.0		5.0		Device
t_{CH}	5.0		5.0		5.0		5.0		5.0		5.0		5.0		Device
t_{CVS}	70.0		48.0		31.0		20.0		6.7		10.0		10.0		Host
t_{CVH}	6.2		6.2		6.2		6.2		6.2		10.0		10.0		Host
t_{ZFS}	0		0		0		0		0		35		25		Device
t_{DZFS}	70.0		48.0		31.0		20.0		6.7		25		17.5		Sender
t_{FS}		230		200		170		130		120		90		80	Device
t_{LI}	0	150	0	150	0	150	0	100	0	100	0	75	0	60	Note 4
t_{MLI}	20		20		20		20		20		20		20		Host
t_{UI}	0		0		0		0		0		0		0		Host
t_{AZ}		10		10		10		10		10		10		10	Note 5
t_{ZAH}	20		20		20		20		20		20		20		Host
t_{ZAD}	0		0		0		0		0		0		0		Device
t_{ENV}	20	70	20	70	20	70	20	55	20	55	20	50	20	50	Host
t_{RFS}		75		70		60		60		60		50		50	Sender
t_{RP}	160		125		100		100		100		85		85		Recipient
t_{IORDYZ}		20		20		20		20		20		20		20	Device
t_{ZIORDY}	0		0		0		0		0		0		0		Device
t_{ACK}	20		20		20		20		20		20		20		Host
t_{SS}	50		50		50		50		50		50		50		Sender

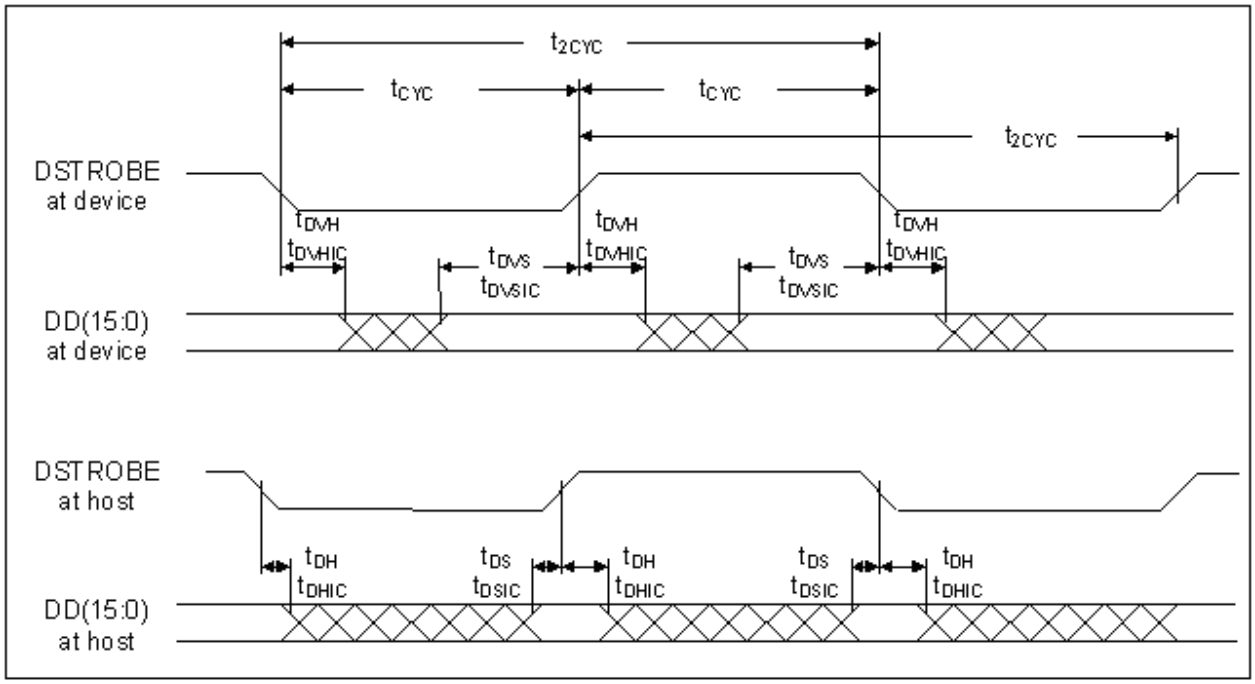
Ultra DMA data burst timing descriptions

Name	Comment
$t_{2CYCTYP}$	Typical sustained average two cycle time
t_{CYC}	Cycle time allowing for asymmetry and clock variations (from STROBE edge to STROBE edge)
t_{2CYC}	Two cycle time allowing for clock variations (from rising edge to next rising edge or from falling edge to next falling edge of STROBE)
t_{DS}	Data setup time at recipient (from data valid until STROBE edge)
t_{DH}	Data hold time at recipient (from STROBE edge until data may become invalid)
t_{DVS}	Data valid setup time at sender (from data valid until STROBE edge)
t_{DVH}	Data valid hold time at sender (from STROBE edge until data may become invalid)
t_{CS}	CRC word setup time at device
t_{CH}	CRC word hold time device
t_{CVS}	CRC word valid setup time at host (from CRC valid until DMACK- negation)
t_{CVH}	CRC word valid hold time at sender (from DMACK- negation until CRC may become invalid)
t_{ZFS}	Time from STROBE output released-to-driving until the first transition of critical timing.
t_{DZFS}	Time from data output released-to-driving until the first transition of critical timing.
t_{FS}	First STROBE time (for device to first negate DSTROBE from STOP during a data in burst)
t_{LI}	Limited interlock time
t_{MLI}	Interlock time with minimum
t_{UI}	Unlimited interlock time
t_{AZ}	Maximum time allowed for output drivers to release (from asserted or negated)
t_{ZAH}	Minimum delay time required for output
t_{ZAD}	drivers to assert or negate (from released)
t_{ENV}	Envelope time (from DMACK- to STOP and HDMARDY- during data in burst initiation and from DMACK to STOP during data out burst initiation)
t_{RFS}	Ready-to-final-STROBE time (no STROBE edges shall be sent this long after negation of DMARDY-)
t_{RP}	Ready-to-pause time (that recipient shall wait to pause after negating DMARDY-)
t_{IORDYZ}	Maximum time before releasing IORDY
t_{ZIORDY}	Minimum time before driving IORDY
t_{ACK}	Setup and hold times for DMACK- (before assertion or negation)
t_{SS}	Time from STROBE edge to negation of DMARQ or assertion of STOP (when sender terminates a burst)

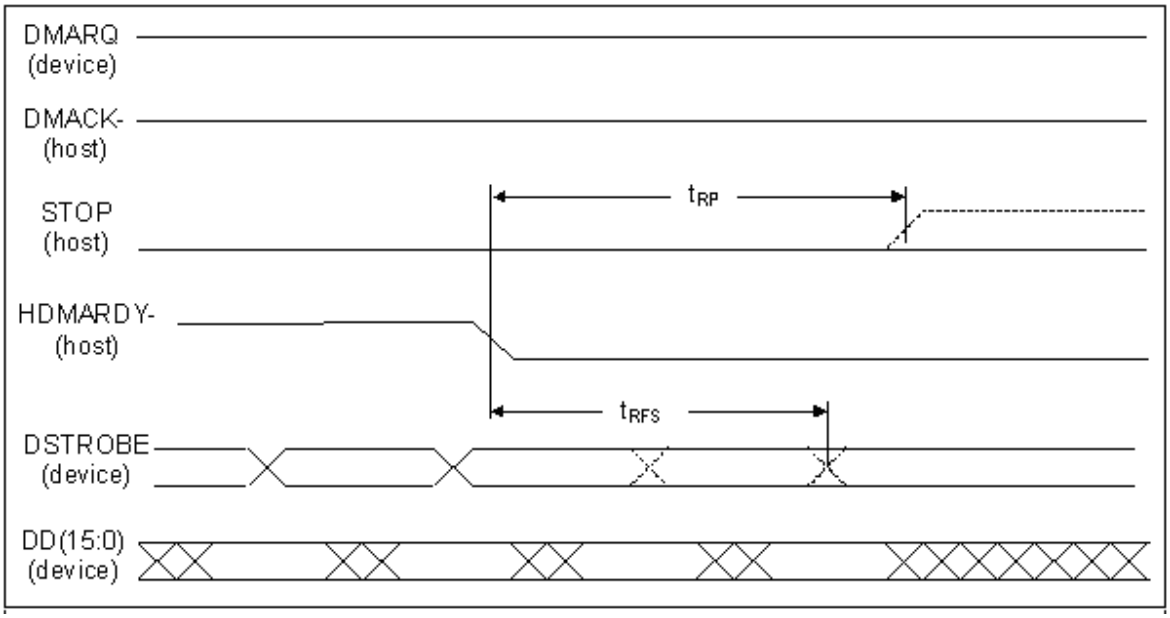
Initiating an Ultra DMA data-in burst



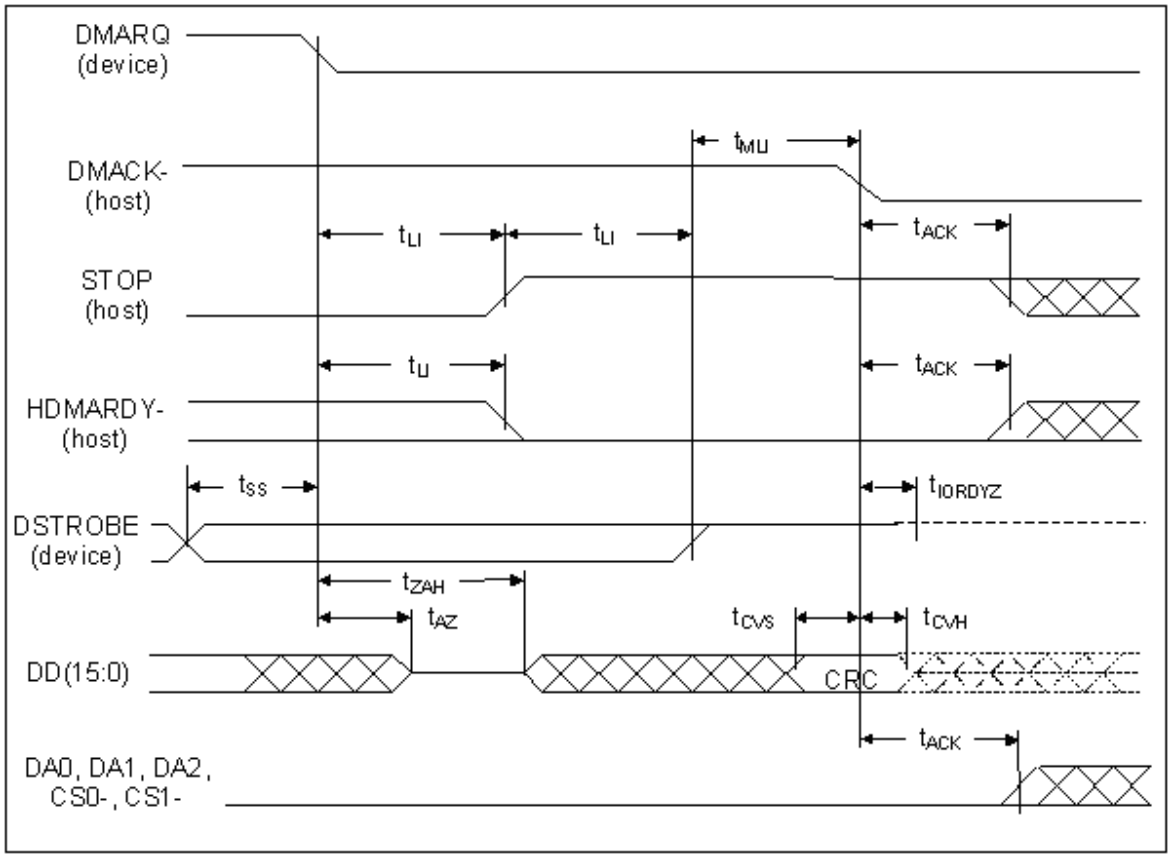
Sustained Ultra DMA data-in burst



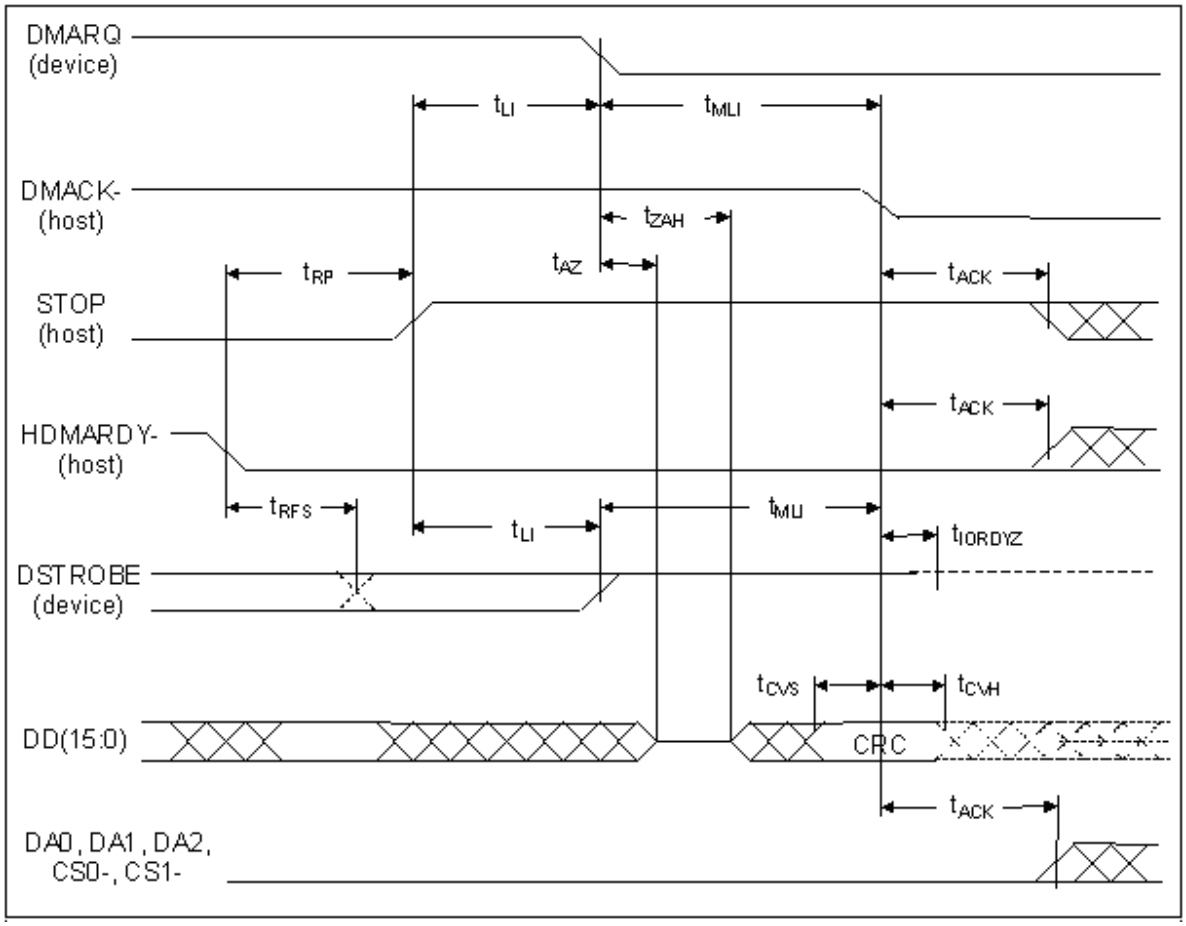
Host pausing an Ultra DMA data-in burst



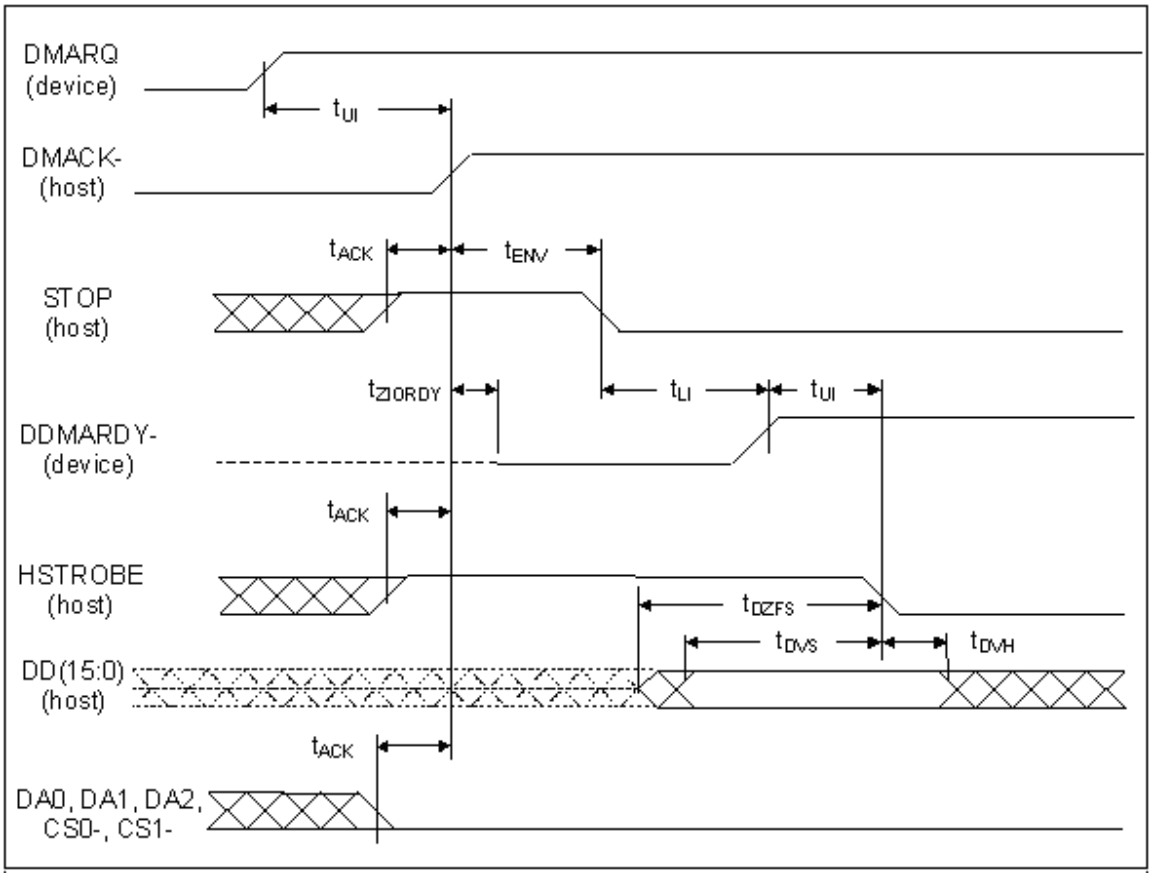
Device terminating an Ultra DMA data-in burst



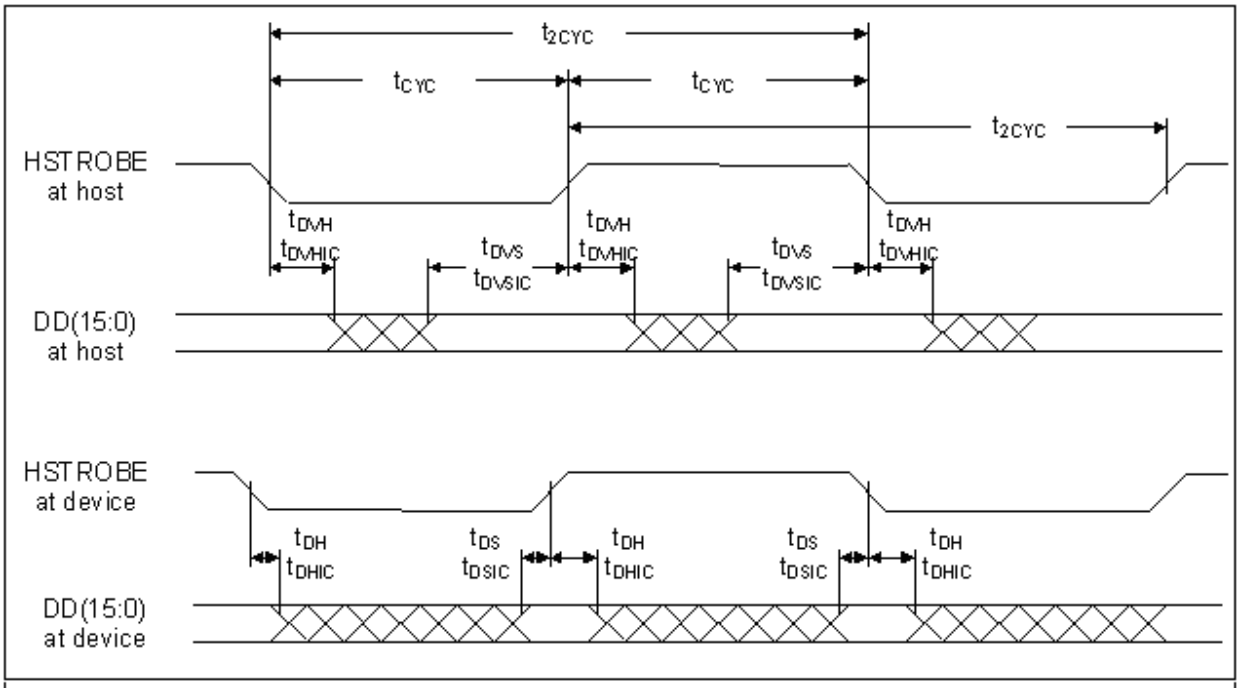
Host terminating an Ultra DMA data-in burst



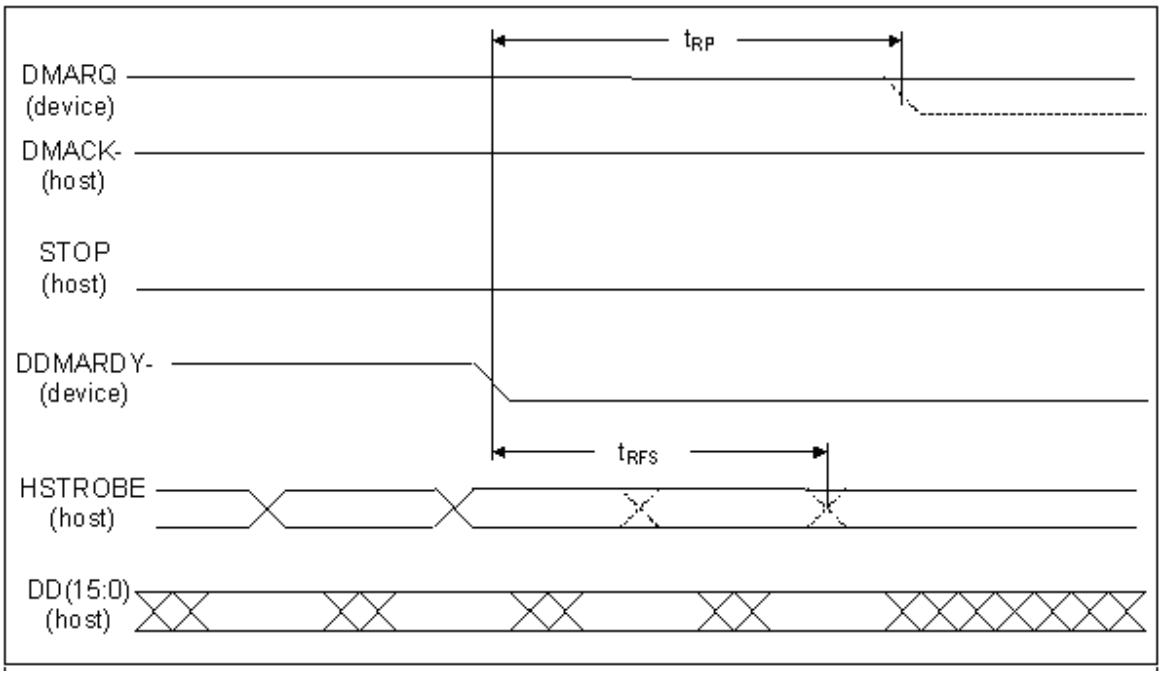
Initiating an Ultra DMA data-out burst



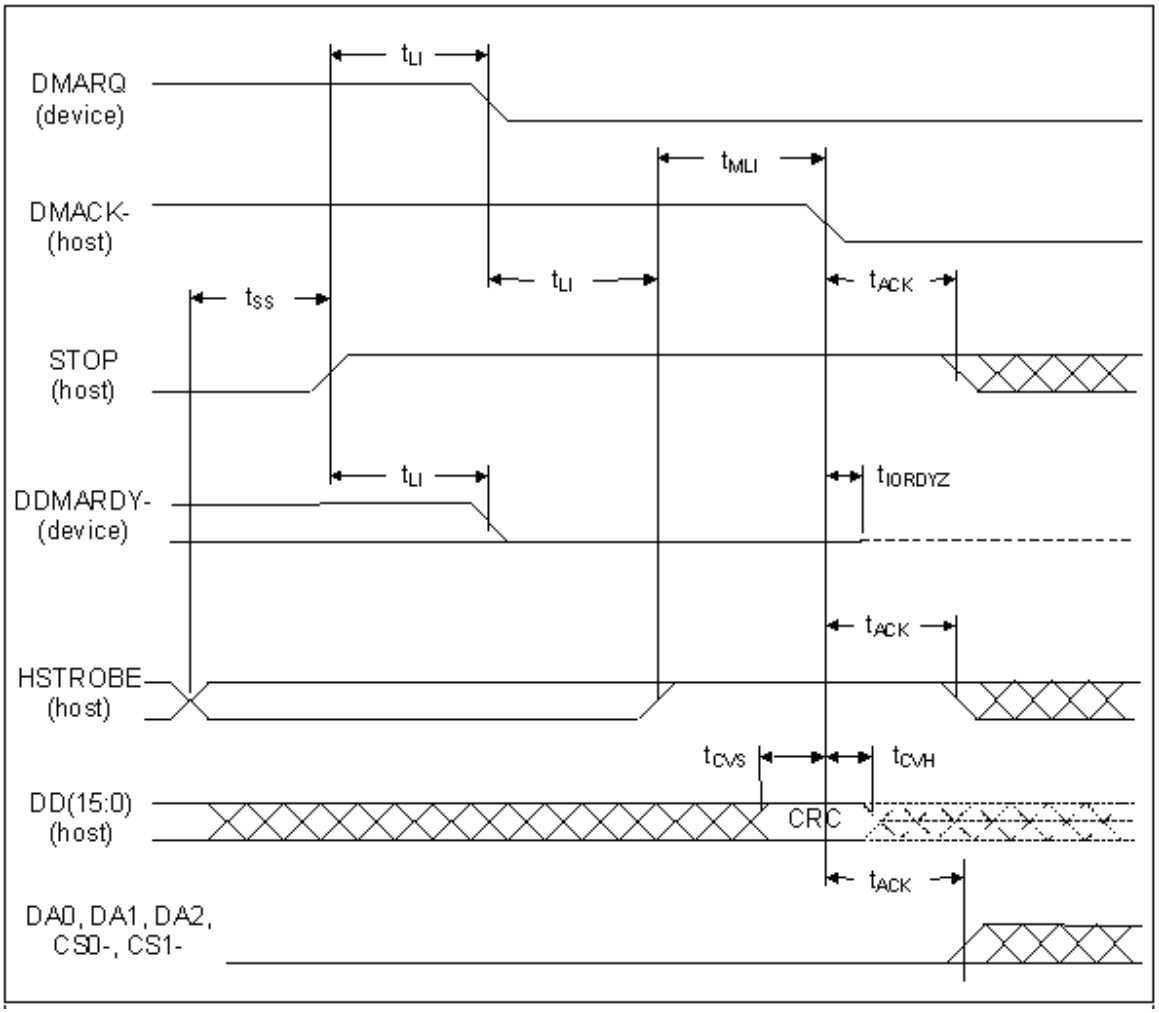
Sustained Ultra DMA data-out burst



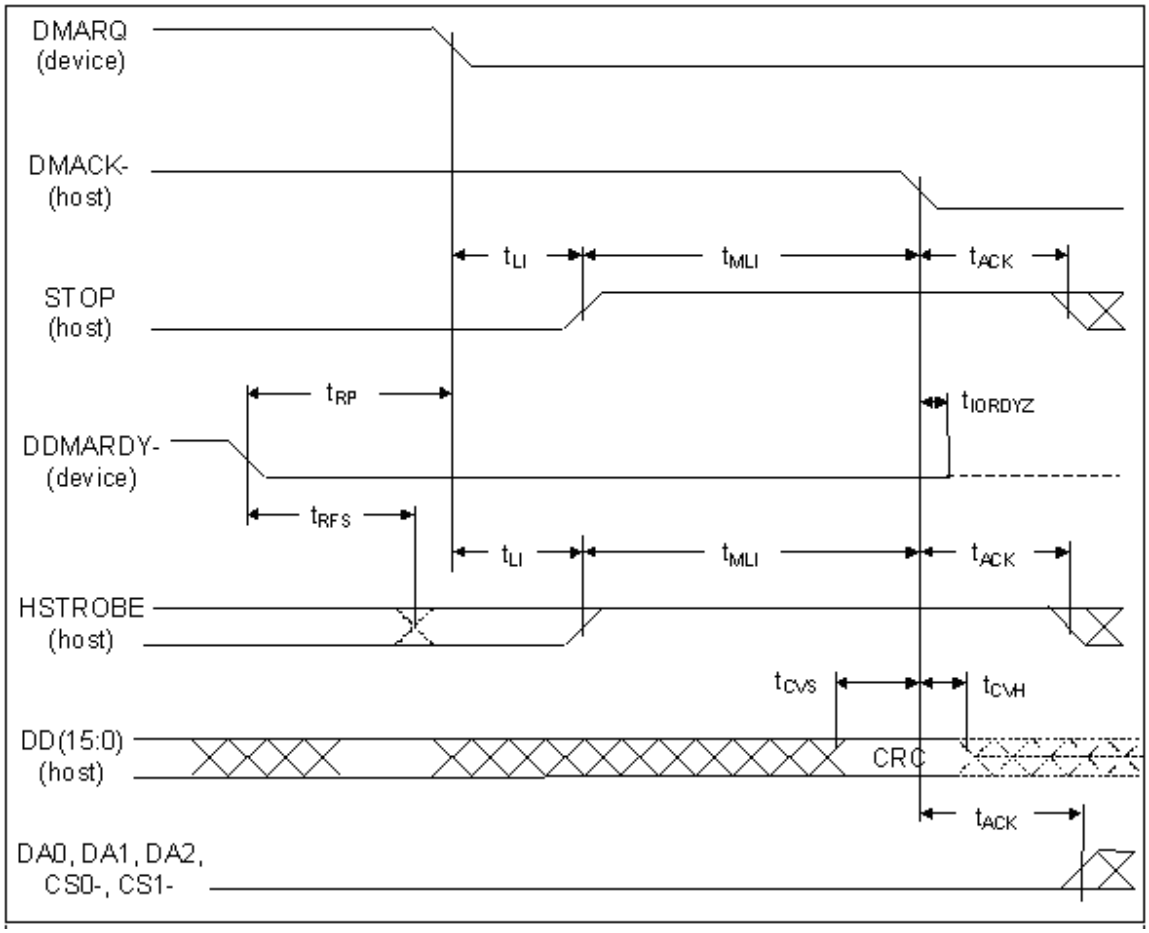
Device pausing an Ultra DMA data-out burst



Host terminating an Ultra DMA data-out burst



Device terminating an Ultra DMA data-out burst

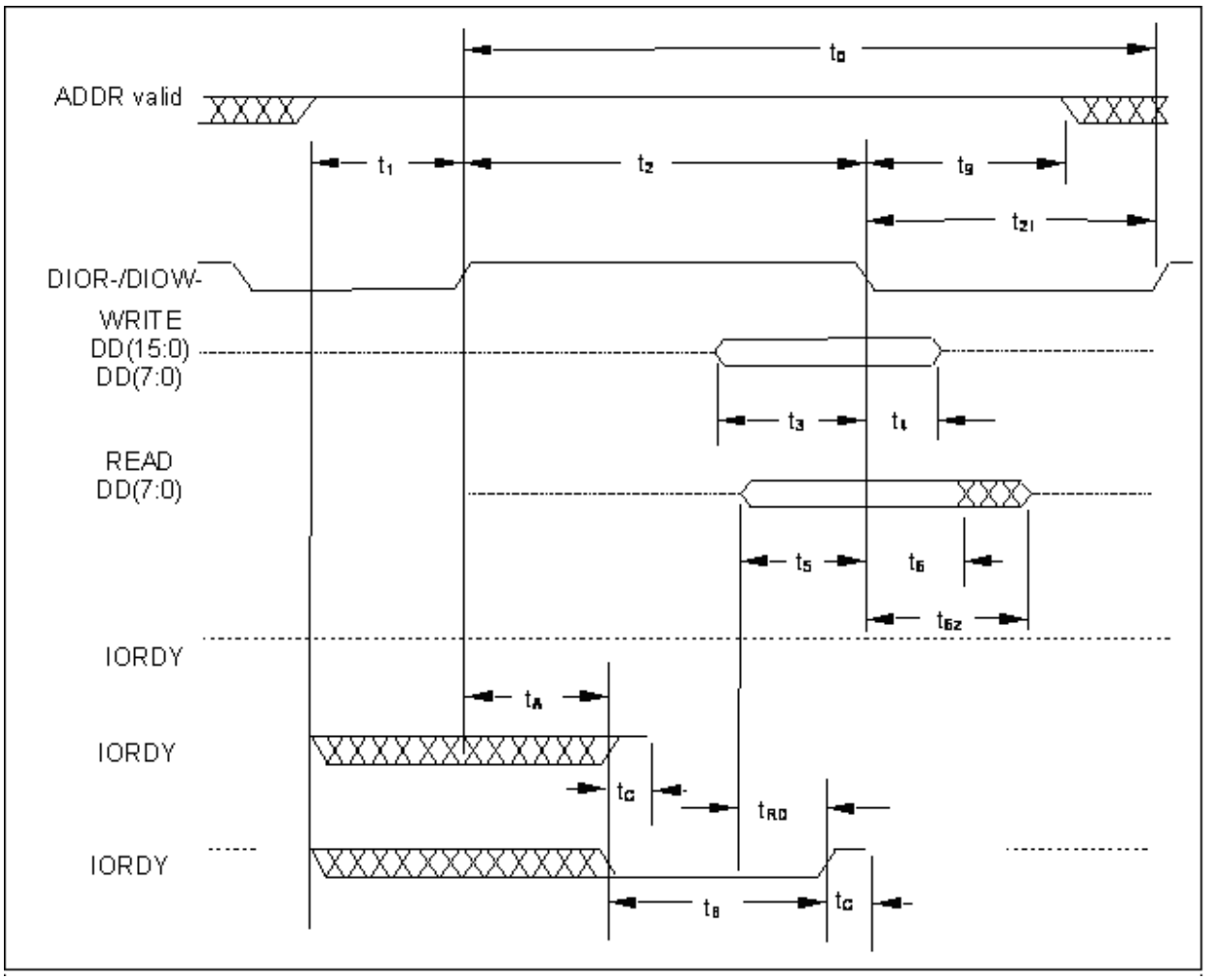


PIO data transfer

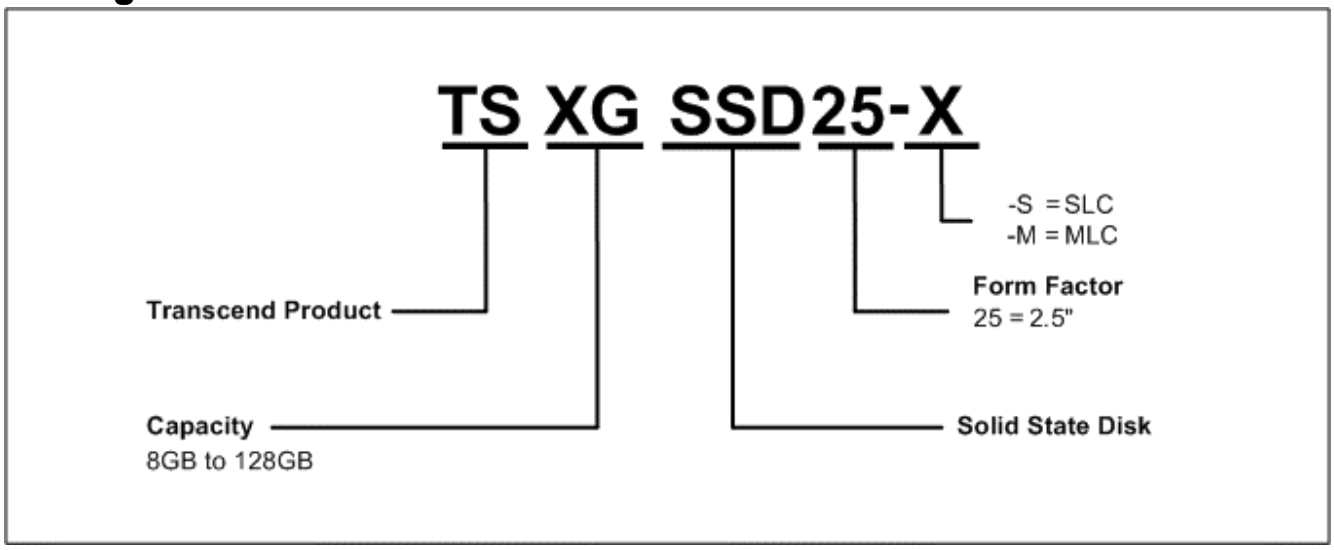
PIO timing requirements

PIO timing parameters			Mode 0 ns	Mode 1 ns	Mode 2 ns	Mode 3 ns	Mode 4 ns
t_0	Cycle time	(min)	600	383	240	180	120
t_1	Address valid to DIOR-/DIOW- setup	(min)	70	50	30	30	25
t_2	DIOR-/DIOW-	(min)	165	125	100	80	70
t_{2i}	DIOR-/DIOW- recovery time	(min)	-	-	-	70	25
t_3	DIOW- data setup	(min)	60	45	30	30	20
t_4	DIOW- data hold	(min)	30	20	15	10	10
t_5	DIOR- data setup	(min)	50	35	20	20	20
t_6	DIOR- data hold	(min)	5	5	5	5	5
t_{6Z}	DIOR- data tristate	(max)	30	30	30	30	30
t_9	DIOR-/DIOW- to address valid hold	(min)	20	15	10	10	10
t_{RD}	Read Data Valid to IORDY active (if IORDY initially low after t_A)	(min)	0	0	0	0	0
t_A	IORDY Setup time		35	35	35	35	35
t_B	IORDY Pulse Width	(max)	1250	1250	1250	1250	1250
t_C	IORDY assertion to release	(max)	5	5	5	5	5

PIO data transfer to/from device



Ordering Information



The above technical information is based on industry standard data and has been tested to be reliable. However, Transcend makes no warranty, either expressed or implied, as to its accuracy and assumes no liability in connection with the use of this product. Transcend reserves the right to make changes to the specifications at any time without prior notice.

TAIWAN
No.70, XingZhong Rd., NeiHu Dist., Taipei, Taiwan, R.O.C
TEL +886-2-2792-8000
Fax +886-2-2793-2222
E-mail: sales@transcend.com.tw
www.transcend.com.tw

USA
Los Angeles:
E-mail: sales@transcendusa.com
Maryland:
E-mail: sales_md@transcendusa.com
www.transcendusa.com
CHINA
E-mail: sales@transcendchina.com
www.transcendchina.com
GERMANY
E-mail: vertrieb@transcend.de
www.transcend.de
HONG KONG
E-mail: sales@transcend.com.hk
www.transcendchina.com
JAPAN
E-mail: sales@transcend.co.jp
www.transcend.jp
THE NETHERLANDS
E-mail: sales@transcend.nl
www.transcend.nl
United Kingdom
E-mail: sales@transcend-uk.com
www.transcend-uk.com
KOREA
E-mail: sales@transcend.kr
www.transcend.co.kr